of Bessel's spheroid, of which the compression is 1/299·2; that is, one more closely approaching a sphere.

In the present state of our knowledge there is no reason to suppose that the curvature of the northern part of America differs any more from that of a general spheroid derived from arcs of all kinds so far measured than local ones in either hemisphere differ among themselves. A comparison of a number of such locally adopted spheroids will bring to evidence the local deformities in the shape of the earth's equilibrium surface and furnishes the geodesists endless material for the study of the earth's actual figure.

The manuscript concludes with a comparative table of the dimensions of several spheroids which of late have come more into prominence. It is as follows :—

| Spheroid of | Equatorial radius, $a$, in metres. | Polar semi-axis $b$, in metres. | $a-b$. | Compression $(a-b)/a$. |
|---|---|---|---|---|
| Bessel, 1841. From ten arcs of the meridian and total amplitude 50° 34′ ........ | 6,377,397 | 6,356,079 | 21,318 | 1/299·15±3·15 |
| Clarke, 1858. Special spheroid for surface of Great Britain and Ireland; range of latitude 12°, the same in longitude; seventy-five astronomic stations ........ | 6,378,494±90 | 6,355,746 | 22,748 | 1/280·4±8·3 |
| Clarke, 1866. From five meridional arcs, of total amplitude 76° 35′ ........ | 6,378,206 | 6,356,584 | 21,622 | 1/295·0 |
| Clarke, 1880. From five meridional arcs and longitudinal measures, total amplitude 88° 59·8′ (equatorial degrees)...... | 6,378,249 | 6,356,515 | 21,734 | 1/293·5 |
| United States Coast and Geodetic Survey, 1900. Eastern oblique arc of the United States; total length, 23° 31′, and eighty-four astronomic stations ........ | 6,378,157±90 | 6,357,210 | 20,947 | 1/304·5±1·9 |
| Harkness, 1891. From "The Solar Parallax and Related Constants," Washington, 1891, p. 138. From a variety of sources........ | 6,377,972±125 | 6,356,727±99 | 21,245 | 1/300·2±3·0 |

N.B.—The ± indicates probable errors.

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A valuable collection of Greek papyri from Oxyrhyncus and the Fayûm has been presented to the University library by the Egypt Exploration Fund.

Dr. A. C. Haddon, F.R.S, University lecturer in ethnology, and professor of zoology in the Royal College of Science, Dublin, has been elected to a junior fellowship at Christ's College.

THE King's Speech to the Commons at the opening of Parliament on Thursday last contained the announcement that "Legislation will be proposed to you for the amendment of the law relating to education."

## SOCIETIES AND ACADEMIES.

### LONDON.

**Royal Society**, February 7.—"The Integration of the Equations of Propagation of Electric Waves." By A. E. H. Love, F.R.S.

The equations of propagation of electric waves, through a dielectric medium, involve two vector quantities, which may be taken to be the electric force and the magnetic force. Both the vectors are circuital; and the several components of them satisfy the partial differential equation of wave propagation, viz. $\phi = c^2\nabla^2\phi$, $c$ being the velocity of radiation.

Owing to the circuital relations, certain known solutions of the partial differential equation of wave propagation are not available, for representing the components of the vectors. A very general system of *particular* solutions, which are available for this purpose, is obtained. These include solutions corresponding to two types of sources of electric radiation:—The sources of one type are similar to infinitesimal Hertzian vibrators, being related in the same way to an axis, but the dependence of the emitted radiation on time is arbitrary; the sources of the other type are obtained therefrom by interchanging the *rôles* of the electric and magnetic forces.

The general integrals of the equations would express the values of the vectors, at one place and time, in terms of their values, at other places and times. To find such integrals, we require (1) sets of particular solutions, which tend to become infinite, in definite ways, in the neighbourhood of chosen points; (2) a theorem of reciprocity, connecting the values, on any chosen surface, of two sets of solutions; (3) the limiting form, assumed by the theorem of reciprocity, when the solutions of one system have the assigned character of infinity at a given point. The solutions required for the first step are among those already found; the theorem of reciprocity is obtained by a modification of the process by which the fundamental equations can be deduced from the Action principle; and the limiting form of the theorem is found by adapting a process due to Kirchhoff. The result is that the radiation which arrives at a chosen point may be regarded as due to a distribution of imagined sources of radiation upon an arbitrary closed surface, separating the point from all the actual sources of radiation. The imagined sources are of the two types previously specified; and the directions of their axes, and the intensities of the radiation sent out from them, are determined simply and directly by the values, on the surface, of the vectors involved in the propagation of the waves.

The general theorem is applied to the problem of the passage of radiation through an aperture, and the result is utilised to determine the rate of decay of the vibrations of a condensing system. The example of a condenser, with concentric spherical conducting surfaces, the outer conducting sheet being perforated by a small circular aperture, is worked out in detail; and the results suggest that the maintenance of the vibrations depends on the screening action of the outer conductor rather than on the largeness of the capacity of the condenser.

**Anthropological Institute**, February 4.—Annual General Meeting.—Mr. C. H. Read, president, in the chair.—On a ballot the following were elected to office for the ensuing year:—President: Prof. A. C. Haddon, F.R.S. Vice-presidents: A. J. Evans, W. Gowland, Prof. G. B. Howes. Hon. Treasurer: A. L. Lewis. Hon. Secretary: J. L. Myres. Council: Sir T. H. Holdich, Sir C. E. Peek, Messrs. G. M. Atkinson, H. Balfour, W. Crooke, Prof. D. J. Cunningham, W. L. H. Duckworth, R. W. Felkin, H. O Forbes, J. G. Garson, E. S. Hartland, T. V. Holmes, E. F. im Thurn, A. Keith, R. B. Martin, M.P., R. H. Pye, E. G. Ravenstein, Prof. W. Ridgeway, W. H. R. Rivers and F. C. Shrubsall. After reading and discussion of the reports of the treasurer and council, the retiring president proceeded to give his address. After alluding to the death of Her Majesty Queen Victoria and paying a tribute to Lieut.-General Pitt-Rivers, an ex-president of the Institute, Prof. Max Müller, Miss Kingsley and other distinguished Fellows who had been removed by death, he went on to call attention to the progress made by anthropology, more especially in the British Empire, during the past year. A joint memorial of the Folk-lore Society and the Institute had been presented to the Government, urging the theoretical and practical importance of an inquiry into the status of native races in South Africa. In India, in combination with the census, a scheme for a partial ethnographical survey had been called into existence, over the working of which the Hon. H. H. Risley would preside. He hoped that in England we should soon have chairs of anthropology at all the important teaching centres; Birmingham had a great opportunity of founding a professorship; at Cambridge, if a sum of 200*l*. or 300*l*. could be guaranteed for a few years, a chair could be established; this was an opportunity for an Englishman to emulate the good works of American millionaires in coming to the aid of science. Not only in respect of teaching, but also in respect of ethnographical collections and accommodation for them, was Great Britain far behind other nations. (See p. 402.)

**Geological Society**, Feb. 6.—Mr. J. J. H. Teall, F.R.S., president, in the chair.—On the structure and affinities of the Rhætic plant *Naiadita*, by Miss Igerna B. J. Sollas, Newnham College, Cambridge. (Communicated by Prof. W. J. Sollas, F.R.S.) This plant, the remains of which are found in Gloucestershire, was considered to be a monocotyledon by Buckman, but a moss by Starkie Gardner. Material supplied by Mr. Seward and Mr. Wickes has given the authoress ground for the belief that *Naiadita* is an aquatic lycopod, and that it is the earliest recorded example of a fossil member of the Lycopodiaceæ, resembling in proportions and outward morphology the existing representatives of the group.—On the origin of the Dunmail Raise (Lake District), by Richard D. Oldham. The conclusion arrived at is that the gap of the Dunmail Raise was formed by a river, which flowed across the hills from north to south and cut down its channel *pari passu* with the elevation of the hills. The final victory of upheaval over erosion, whereby this river was divided into two separate drainage-systems and the barrier of the Dunmail Raise upheaved, may have synchronised with a diversion of the head-waters and consequent diminution of volume and erosive power. It is pointed out that this explanation comes into conflict with previously published theories of the origin of the drainage-system of the Lake District, inasmuch as the elevation postulated seems too slow to be explicable by the intrusion of a laccolite; and that the existence of a large river crossing the area of upheaval, and the maintenance of its character as an antecedent river-valley for a long period, show that the surface was originally a peneplain of subaërial denudation, and not a plain of marine sedimentation or erosion. From this it follows that the course of the main drainage-valleys may not have been determined by the original uplift, but, with the exception of those which are old river-valleys, whose direction of flow has been reversed on the northern side of the uplift, may have been formed by the cutting-back by erosion into the rising mass of high ground—in other words, that the principal valleys of the Lake District may be subsequent, not consequent, in origin.

### Manchester.

**Literary and Philosophical Society**, February 5.—Prof. Horace Lamb, F.R.S., president, in the chair.—Mr. T. Thorp and Dr. C. H. Lees were nominated as auditors for the current year.—Prof. Flux referred to the records of a recent report on water, gas and electricity undertakings, so far as they showed the rate of return on the capital invested in each case. The rates were grouped most thickly about 3 to 3½ per cent. for each class of enterprise, more closely in the case of water and, in a less degree, of gas than in the case of electricity. The total number of undertakings contributing to the result named was 1351, and the lowness of the figure representing the most frequent rate seemed rather striking.—Mr. Thomas Thorp mentioned that he had made further progress with an instrument designed to yield a pure monochromatic image of the sun, and had been able to obtain results of an encouraging nature. He hoped to be able to perfect the instrument in a short time and to exhibit it before the Society.—Dr. George Wilson read a paper, prepared by Mr. H. Noble and himself, entitled "Note on the construction of entropy diagrams from steam-engine indicator diagrams," showing how the effect of the clearance steam may be taken account of in the ordinary pressure-volume curve, thus enabling trials of different engines to give directly comparable results.—Mr. C. E. Stromeyer read a paper on the representation on a conical mantle of the areas on a sphere, in which he showed that the representation of points on the surface of a sphere on an enveloping cone, the distance of corresponding points on sphere and cone from the vertex of the cone being equal, gives a map on the developed cone the areas on which are proportional to those on the sphere.—The president announced at the close of the meeting that April 22 had been provisionally fixed for the delivery of the postponed Wilde Lecture by Dr. Metchnikoff.

### Edinburgh.

**Mathematical Society**, February 8.—Note on the cooling of a sphere in a finite mass of well-stirred liquid, by Dr. Peddie.—Some inequalities relating to arithmetic, geometric and other algebraic means, by R. F. Muirhead.

### Paris.

**Academy of Sciences**, February 11.—M. Fouqué in the chair.—On the generation of the hydrocarbons by the metallic carbides, by M. Berthelot. From an examination of the thermochemical data concerning the metallic carbides, it is shown that the condition that an acetylide on treatment with water should give acetylene is that the difference between the heats of formation of the metallic hydrate and acetylide should be greater than 196·1 calories. This is the case with the carbides of the alkalies and the alkaline earths, but not for the acetylide of silver, and this latter compound is accordingly not decomposed by water. The cause of the production of a complicated gas mixture in some cases is also discussed from a thermochemical point of view.—Observations on the solutions of solid metals in mercury, and more generally in other fused metals, by M. Berthelot. It is pointed out that the use of the word solution to express the uniform distribution of a metal in mercury is not, strictly speaking, parallel to ordinary solution.—On precession, by M. O. Backlund. Correcting an error in a previous note.—On the specific heats of fluids, the elements of which are submitted to their mutual actions, by M. P. Duhem. It is shown that all the laws demonstrated in elementary thermodynamics for a fluid submitted to a normal and uniform pressure may be extended to a fluid the elements of which exercise any actions whatever upon each other, whether Newtonian or not.—On the photography of the solar corona in solar eclipses, by M. H. Deslandres. An account of the methods employed and the results obtained on the photography of the sun's corona during the solar eclipse of May 28, 1900.—On the theory of the satellites of Jupiter, by M. J. J. Landerer. A comparison of the results of observation with the theory of Souillart.—A new class of algebraic surfaces which admit of a continuous deformation and still remain algebraic, by M. D. Th. Egorov.—On certain transformations of Backlund, by M. Clairin.—On the theorem of Hugoniot and the theory of characteristic surfaces, by M. J. Coulon.—On a class of partial differential equations of the second order, by M. R. d'Adhémar.—On the linear partial differential forms of a system of simultaneous differential equations which are also the integrals of this system, by M. A. Buhl.—On circular arches, by M. Ribière.—On the diurnal variation of the magnetic declination, by M. Alfred Angot.—Calculation of the formula giving the law of the regular distribution of the horizontal component of the earth's magnetism in France on January 1, 1896, by M. E. Mathias.—An electric anemometer indicating at a distance, by M. Emmanuel Legrand. The motion of the vanes of the anemometer drives a small Gramme ring, the current from which is connected to a d'Arsonval galvanometer at a distance. The electromotive force produced is proportional to the velocity of rotation of the vane.—Telephonic communication by means of a wire stretched across the snow, by M. A. Ricco.—Remarks on the preceding communication, by M. Janssen.—The law of transparency of matter for the X-rays, by M. Louis Benoist. The specific opacity of a body to the X-rays is independent of its physical state, of the mode of atomic grouping and of the state of liberty or combination of the atoms. For X-rays sufficiently penetrating and homogeneous, the specific opacity of elements is a determinate and increasing function of the atomic weight, the two magnitudes being approximately proportional.—New researches on electric convection, by M. V. Cremieu. The author has repeated some of his original experiments with additional precautions, and considers it finally established that under the conditions of the experiments of Rowland and Himstedt electric convection produces no magnetic effect.—On musical impressions, by M. Firmin Larroque.—On the formation and decomposition of the acetals, by M. Marcel Delépine. The formation of acetals is a limited reaction, a state of equilibrium being set up between the alcohol, acetal, aldehyde and water. The results of experiments upon the limiting values of this reaction are given for methylal, dipropyl formal, erythrite diformal and mannite diformal.—On the elimination of methane from the atmosphere, by M. V. Urbain. Recent researches by MM. Muntz and Aubin and by M. Gautier on the amount of methane in the atmosphere, compared with those of Boussingault, show that the proportion of this gas has not increased. Hence, like carbonic acid, it would appear to be eliminated in some way. By an extensive series of experiments, the author shows that this elimination is effected by plants.—Actions of the esters of the monobasic fatty acids upon the mixed organo-magnesium compounds, by M. V. Grignard. The use of magnesium has the advantage over the Wagner-Satzeff reaction not only in its simplicity and increased yield, but also in increased generality. Thus ethyl formate and magnesium ethyl bromide gives a 73 per cent. yield of diethylcarbinol; with isoamyl bromide of magnesium and ethyl formate the formate of diisoamylcarbinol is obtained. Diisobutylcarbinol can be prepared by the analogous reaction.—On the absorption of light by the indophenols, by MM. P. Bayrac and C. Camichel.—On the acid and alcoholic combinations of phenylcarbazide, or the urea of phenylhydrazine, by M. P. Cazeneuve.—Ketones from wood tar, by M. A. Behal. The ketone, dimethylcyclohexonone, has been isolated from the neutral oil of wood tar. Its constitution was determined by means of its oxidation products, potassium permanganate giving only acetic acid and α-levulinic acid.—On dibromo- and diiodobutane: a new synthesis of adipic acid, by M. l'abbé J. Hamonet.—Comparison between the nucleated and non-nucleated red blood corpuscle, by M. R. Quinton. From the point of view of osmosis the nucleated red blood corpuscle differs in its behaviour from the non-nucleated corpuscle, inasmuch as an equilibrium is attained in the former case with urea in solution, but not in the latter.—Blastoderm without an embryo, by M. Gustave Loisel.—Action of the total pressure on the chlorophyll assimilation, by M. Jean Friedel. The diminution of the total pressure tends to favour assimilation. When air containing carbonic acid is rarefied, the assimilation passes first through a minimum and then through a maximum.—On the tuberculisation of the potato, by M. Noel Bernard. It has been previously shown by the author that in certain plants the formation of tubers from the buds is a consequence and a symptom of the infection of the roots by endophytic fungi. Experiments are now given for the potato, confirming these views, and it is pointed out that if this conclusion is exact, it should be possible, by a rational culture of the potato, to increase the size and yield of the tubers.—On a new group of very basic rocks, by M. A. Lacroix.—New observations on the glacial period in the southern Carpathians, by M. E. de Martonne.—The transgressions and the regressions of the secondary seas in the basin of the Aquitaine, by M. Ph. Glangeaud.—Contribution to the study of subterranean waters. Isochronochromatic curves, by M. Félix Marboutin.

## DIARY OF SOCIETIES.

### *THURSDAY*, FEBRUARY 21.

ROYAL SOCIETY, at 4.30.—An Attempt to Estimate the Vitality of Seeds by an Electrical Method: Dr. Waller, F.R.S.—On a New Manometer, and on the Law of the Pressure of Gases between 1·5 and ·01 millimetres of Mercury: Lord Rayleigh, F.R.S.—(1) An Investigation of the Spectra of Flames resulting from Operations in the Open Hearth and "Basic" Bessemer Processes; (2) The Mineral Constituents of Dust and Soot from various Sources: Prof. Hartley, F.R.S., and Hugh Ramage.—Notes on the Spark Spectra of Silicon as rendered by Silicates: Prof. Hartley, F.R.S.

LINNEAN SOCIETY, at 8.—On the Affinities of *Æluropus melanoleucus*, Alph. Milne-Edw.: Prof. E. Ray Lankester, F.R.S., and R. Lydekker, F.R.S.—Étude d'une espèce nouvelle de Lépapèdes: M. A. Gruvel.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—If the discussion on Mr. Mordey's paper is closed, the following paper will be read:—The Electrical Power Bill of 1900: Before and After: W. L. Madgen.

CHEMICAL SOCIETY, at 8.—(1) Isomeric Hydrindamine Mandelates and Phenylchloracethydrindamides; (2) Isomeric Benzylhydrindamine bromocamphorsulphonates and some Salts of *d-l*-Hydrindamine: F. Stanley Kipping and H. Hall.—Condensation of Phenols with Esters of the Acetylene Series. IV. Benzo-γ-pyrone and its Homologues: S. Ruhemann and H. W. Bausor.—Constitution of Bromocamphoric Anhydride and Camphanic Acid: A. Lapworth and W. H. Lenton.—The Action of Acetylchlor- and Acetylbrom-aminobenzenes on Amines and Phenylhydrazine: F. D. Chattaway and K. J. P. Orton.

### *FRIDAY*, FEBRUARY 22.

ROYAL INSTITUTION, at 9.—Metals as Fuel: Sir W. Roberts-Austen, F.R.S.

PHYSICAL SOCIETY, at 5.—How Air subjected to X-Rays loses its Discharging Property, and how it Discharges Electricity: Prof. Emilio Villari.—(1) On the Propagation of Cusped Waves and their Relation to the Primary and Secondary Focal Lines; (2) On Cyanine Prisms, and a New Method of Exhibiting Anomalous Dispersion: Prof. R. W. Wood.

INSTITUTION OF CIVIL ENGINEERS at 8.—Automatic Coupling: J. L. Cridlan.

### *SATURDAY*, FEBRUARY 23.

ROYAL INSTITUTION, at 3.—Sound and Vibrations: Lord Rayleigh, F.R.S.

ESSEX FIELD CLUB (Essex Museum of Natural History Stratford), at 6.30.—Recent Work in Molluscan Morphology: Prof. G. B. Howes, F.R.S.

### *MONDAY*, FEBRUARY 25.

ROYAL INSTITUTION, at 3.—Practical Mechanics: Prof. J. A. Ewing, F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Some Aspects of South American Geography: Colonel G. E. Church.

SOCIETY OF ARTS, at 8.—The Bearings of Geometry on the Chemistry of Fermentation: W. J. Pope.

INSTITUTE OF ACTUARIES, at 5.30.—The Increase of Cancer: R. Teece.

### *TUESDAY*, FEBRUARY 26.

ROYAL INSTITUTION, at 3.—The Cell as the Unit of Life: Dr. A. Macfadyen.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Rotatory Process of Cement Manufacture: W. H. Stanger and Bertram Blount.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Notes from Five Years' Work with X-Rays: W. Webster.

### *WEDNESDAY*, FEBRUARY 27.

SOCIETY OF ARTS, at 8.—The Outlook for the World's Timber Supply: Dr. W. Schlich.

### *THURSDAY*, FEBRUARY 28.

ROYAL SOCIETY, at 4.30.

SOCIETY OF ARTS, at 4.30.—Railways and Famine: Horace Bell.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Conclusion of discussion on Mr. Madgen's paper.—Followed, if possible, by Cables: M. O'Gorman.

### *FRIDAY*, MARCH 1.

ROYAL INSTITUTION, at 9.—Enamels: H. H. Cunynghame.

GEOLOGISTS' ASSOCIATION, at 8.—The Post-Pliocene Non-Marine Mollusca of the South of England: A. S. Kennard and B. B. Woodward.—The Pleistocene Fauna of West Wittering, Sussex: J. P. Johnson.

### *SATURDAY*, MARCH 2.

ROYAL INSTITUTION, at 3.—Sound and Vibrations: Lord Rayleigh.

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